DEPARTMENT OF NOTES, REVIEWS, ETC.

It is the purpose, in this department, to present from time to time brief original notes, both of methods of work and of results, by members of the Society. All members are invited to submit such items. In addition to these there will be given a few brief abstracts of recent work of more general interest to students and teachers. There will be no attempt to make these abstracts exhaustive. They will illustrate progress without attempting to define it, and will thus give to the teacher current illustrations, and to the isolated student suggestions of suitable fields of investigation.—[Editor.]

A CHART ON GENERAL PLANT HISTOLOGY AND PHYSIOLOGY

The valuable teaching aid afforded by charts and diagrams of various sorts is well understood by most teachers of biology who are more or less well acquainted with the numerous current sets of charts offered to the profession. There are a few teachers who possess the enviable talent of rapidly constructing excellent blackboard sketches during a given lecture or laboratory period to illustrate the particular features or phenomena under study at that particular time. Some instructors have made use of the more permanent crayon sketches on sheets of drawing paper hung over an easel. The uses of the various lantern-slide, opaque, vertical and micro-projection possibilities are also utilized to a very desirable degree under certain circumstances.

The principal pedagogical difficulty which all teachers have probably experienced in the practical application of these or other useful adjuncts of the same general kind to teaching is, that at best the student gets a disjointed presentation of the subject in question for the reason that the subject matter must be presented more or less disjointedly and interruptedly because of the many other things which we compel him to study. The student suffers from this regular lack of continuity. He loses much because of his failure to see the real position of a given structure or place of a given activity in the organism as a whole.

I may illustrate my meaning here by a reference to the common practice in teaching some of the phases of botany, say phytohistology. Probably students may be found in every class in plant histology as that subject is currently taught, who, knowing right well the detailed characteristics of all of the common tissues of the vegetable kingdom and how to handle the histological technique involved

in the preparation of such tissues, may fail utterly to acquire an adequate knowledge of the place and function of those tissues in the plant as a whole. In fact such students may not even know where in the plant to find a given tissue if they are thrown upon their own resources, resources derived from their histology courses. Surely it is most difficult for them to really understand the function of the various tissues of the plant if they do not know the position of the tissues within the plant.

The same general state of affairs sometimes exists in plant physiology. The student may understand the various fundamental processes of the plant very well, but he often fails to read through the whole series of interrelated activities and to visualize, as it were, the individual plant as a completely equipped and working entity.

The most fundamental process in all nature is photosynthesis. Consequently it is quite desirable that the student of general biology, of general botany, surely of general physiology and general science should understand at least the fundamental features and the significance of that great phenomenon. He should know photosynthesis as it occurs in the leaf, of course, but he should also know about many of the other processes and structures which make the photosynthetic manufacture of carbohydrates in the leaf possible. He must know quite well many of the interrelations of the various activities of the plant if he wishes to really understand photosynthesis. He must see the plant as a completely constructed mechanism with its various parts working together in harmony. It is the business of the teacher to see to it that he does get this notion definitely outlined in his mind.

Now to be sure that our students really *get* all of this and this point of view of the plant, requires more than a little thought on the part of the teacher as to the methods of instruction that are to be followed in the class-room and laboratory. Sometimes I have thought that some of the common difficulties in this connection might be lessened if the class were to take a single common plant, say the sunflower, castor bean or scarlet runner, and work out its entire structural and physiological life-history from the embryo in the seed through the development and maturation of the new individual

including the new fruit and seed. If the exercises on histology and physiology were properly correlated at every point possible I believe that such a method would result in giving to the student an admirable introduction to many of the fundamentals of general botany. At the conclusion of such a course the student would have secured an admirable and useful insight into the most of the important plant phenomena. And I believe that he would actually retain a definite mental picture of what the plant *is* as a *mechanism* and what it *does* as a *living, working* organism. From such a course he would surely obtain a connected view of these matters and he would not think of the plant as composed of a group of parenchyma cells here, a strand of fibers there, an irregular patch of epidermis somewhere else. He would not stop to wonder how and from whence the root gets the necessary food for its growth or how it is possible for growth to begin in a tree in early spring before the leaves have unfolded their chlorophyll-containing tissues.

Something of the same results may be secured by the skillful teacher from a carefully planned summary of the whole matter in which the various interrelations and correlations are plainly worked out. I have found in my own department that generalized drawings aid greatly in connection with such summaries. An illustration which brings before the student by means of a single chart or page many of the essentials has been found most useful by myself and the other instructors in my department. The late Professor Bessey was a master in preparing such diagrams. His specialty was, as all know, the preparation of figures to show lines of descent and evolution of the groups of the plant world. Whether one could agree as to the derivations and progress of evolution represented by his diagrams or not did not detract from the fact that his figures helped greatly to portray the principles and the theories that he wished to emphasize. Thousands of his students were enabled to secure a much better idea as to what evolution really is from such methods even if they went no further in their study of biology than the Freshman course.

Figures or diagrams of this sort may be studied indefinitely and the longer they are examined the more illuminating they become until the average student is enabled to secure a complete and prop-

THE HISTOLOGY AND PHYSIOLOGY OF THE PLANT

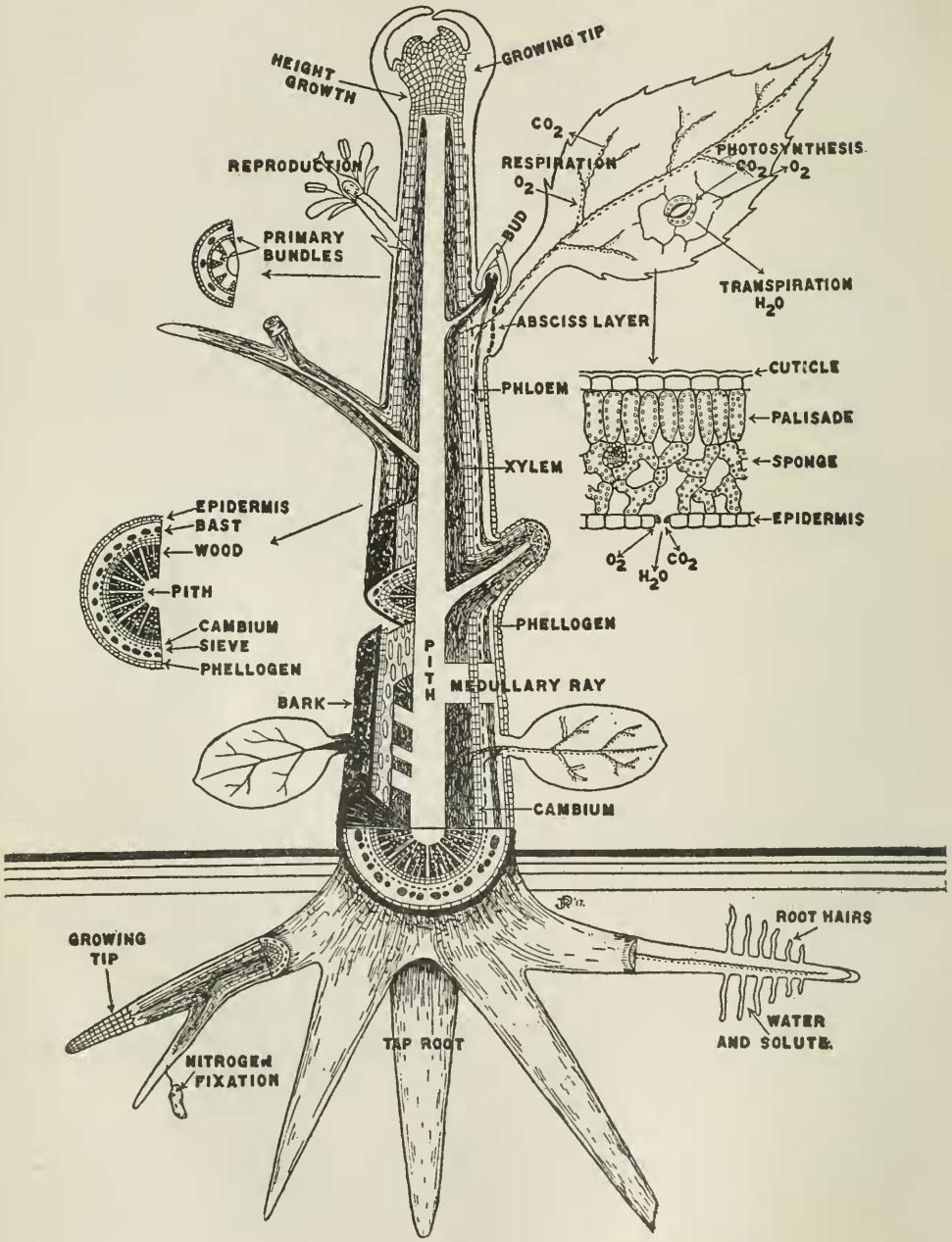

PLATE VI

erly balanced conception of the chief features of the subject in question.

Such figures may be constructed in great detail and with much technical skill or they may be more or less crude and diagrammatic and still be of great value to the learner. With the information gained from careful studies of plant anatomy and plant processes the student should be able to fill in the missing details of a generalized drawing and to interpret properly the diagrammatic features of the figure. This being possible, a diagram of the kind submitted herewith should be exceedingly helpful and, indeed, illuminating. It was solely because of the success of these methods in this department that I was led to publish these brief notes and the diagram in the hope that they might be suggestive in some degree to my fellow workers in biological fields.

The figure as published here has been revised and redrawn from a similar figure published in 1914 by the writer in a laboratory manual of plant physiology. The older diagram was later enlarged and worked out in the form of a wall chart. The reader will understand, of course, as he looks at this diagram that the relative proportions of the various structures exhibited are not intended to be represented at all as they actually occur in the living plant. In fact the proportions are mostly so unnatural as to be grotesque and even misleading if the student or reader does not understand how to interpret them in the light of what has been said in the above paragraphs. He is supposed to have acquired this understanding in his courses of study dealing with the plant. The figure merely helps him to *see* the *interrelations* of the facts of histology and physiology graphically summarized in the features of the chart. The chart represents in a more or less diagrammatic manner an epitome of the great facts of histology and physiology. Many additional entries might be made upon the chart, but the danger is in so multiplying details that the real purpose of the sketch may be obscured behind the maze of unessential details. That would be a serious blunder in the use of this method of teaching or learning.

I believe that it is one of the chief duties of a teacher to epitomize very carefully his subject as fully as possible by whatever

methods he may devise. In so far as he is successful in this practice so far will the students in his classes carry away with them a definite and compact and possibly useful body of knowledge upon the subject taught. Such a chart as this has been found very useful in such an epitome, and the method in general is successful in application.

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A METHOD FOR MOUNTING ANATOMICAL PREPARATIONS FOR EXHIBITION

Oftentimes students in comparative anatomy make excellent preparations which are worthy of preservation. But this is not done as a rule because of the trouble in mounting. A glass strip of just the right size to fit into the exhibition jar must be found. The preparation is with difficulty tied by thread to the glass plate. If one could only "pin" into glass! The following method is suggested as a solution. A mixture of hard paraffin, beeswax and lampblack is melted up and poured into a paper box cover about the size needed had a glass plate been used. The mixture in the cover should be between ¼ and ½ inch deep. It should be allowed to cool somewhat and then on this bed the preparation should be placed and pressed down into it somewhat. A few small pins can easily be made to fasten it securely. When the matrix is cooled they can be clipped off on the back. Labels can also be easily attached to parts of the dissection. The entire cover can now be placed in cold water for a few minutes. When hardened the cover can be cut away with a knife—the paraffin background cut down to just the size that will fit into the glass jar—care being taken to make it fit in snugly. The jar can now be filled with formalin and the cover fastened on. The black background makes the objects stand out distinctly and the preparation never becomes loosened from its wax bed. The whole operation takes but a few minutes time.

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